

# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Apparatus for Descaling Pipes

I, ALBERTO JOHANN REINHART, a Swiss Citizen, of 24, via Cortivallo, Lugano, Switzerland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns the descaling of pipes.

A method is known for descaling water, gas or the like pipes, tubes or conduits (hereinafter referred to generally as "pipes" for the sake of convenience) by mechanical means which pipes become blocked in time by deposits of lime, rust or other materials. According to this method a scraping device is pushed into the pipe, with the help of a driving device, which utilizes a part of the energy of water or some other liquid which is forced under pressure into the pipe to be cleaned.

The object of the present invention is to provide a novel form of apparatus for descaling pipes, which operates on this principle. This apparatus, thus, has a thrusting device, which utilises a part of the energy of any liquid flowing through the pipe to be cleaned, and is characterised by a first unit, comprising at least two cutting and scraping tools, followed by the thrusting device aforesaid which, for its part, is followed by a second unit comprising at least two crushing tools, the various tools and the thrusting device being connected together by hinges which permit the apparatus to pass through curved sections of pipe, and further characterised in that each of the cutting and scraping tools has a row of knives which extend in the manner of the edges of a pyramid and by means of a flexible system are pressed against the wall of the pipe which system includes a group of springs, of which each operates on one of the knives and is mounted on a sleeve displaceable on an axial bar to which the knives are hinged and comprises also a spring which surrounds the bar and pushes back the sleeve, each knife

moreover having a front part for cutting into deposits in a radial plane and a back part, V-shaped, for penetrating into grooves produced by the knives for breaking up the deposits and at the same time scraping the pipe wall, whilst the crushing tools also have ribbed rollers pressed flexibly against the wall, the whole in such a manner that the V-shaped parts scrape the whole periphery of the wall and the rollers crush the deposits between themselves and the wall, in that they are displaced mainly in an axial direction.

The attached drawings show, by way of example, one embodiment of apparatus according to the invention.

Fig. 1 is a diagrammatic plan view of the whole apparatus,

Fig. 2 is an axial section through the first cutting and scraping tool of the apparatus of Fig. 1,

Fig. 3 is a partial front view of the front part of the tool of Fig. 2,

Fig. 4 is a partial section taken on the line IV—IV of Fig. 2,

Fig. 5 is a plan view of one of the knives of the tool of Fig. 2,

Fig. 6 is a part-sectional view of the front part of the second cutting and scraping tool of the apparatus of Fig. 1,

Fig. 7 is a plan view of a torsionally strong hinge connection of the apparatus of Fig. 1,

Fig. 8 is a similar view of a ball joint connection of the apparatus,

Fig. 9 is an axial section through the crushing tool of the apparatus of Fig. 1,

Fig. 10 is a plan view of a roller support arm of the tool of Fig. 9, and

Fig. 11 is a partial front view of the crushing tool.

The apparatus illustrated comprises a first unit forming the front part of the arrangement and which consists of two scraping tools 1 and 3, followed by a thrusting device 5 which itself is followed by a unit constructed from two crushing tools 7 and 9. The first cutting

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and scraping tool 1 is connected to the second tool by means of a hinge device 2; the second unit and scraping tool is coupled to the thrusting device 5 by means of a hinge device 4. The connection between the thrusting device 5 and the first crushing tool 7 and between the latter and the similar tool 9 is provided by a hinge device 6 and 8. The hinge connections 2, 4 and 8 permit the various units to incline relative to each other in all directions, but not to rotate against one another. The hinge device 6 on the other hand also permits a relative rotation of the groups 1, 3 and 5 in relation to the crushing tool pair. This is necessary because the crushing unit is inclined to turn round its own axis when pushing forward in a pipe whereas the unit 7, 9 does not rotate at all; the unit containing the scraper 1, 3 on the other hand can follow the thrusting unit 5 in its rotational movements and for this reason the hinge connections 2 and 4 can be torsionally strong.

The cutting and scraping tool 1 surrounds a centre bar 11 (See Fig. 2) on the front end of which a sleeve 12 is mounted. A nut 15 screwed on to the end of the bar is provided with a stirrup 16 which is welded on, to which a cable can be connected for raising the apparatus and a helical spring 17 is supported by a sleeve 19 which is disposed on a nut 21 screwed on to the bar 11. The back end of the bar 11 has an eye 11<sup>1</sup> which is used for coupling the bar to the hinge device with the help of a pin or a bolt.

The sleeve 12, for its part, supports a ring 13 which is mounted on said sleeve by means of screws 22, which represents together a raised arched structure. The ring 13, together with the knives, forms a cutting head which is used to open an entry through deposits which can build up right into the central or axial zone of the pipes. The front of the sleeve 12 opposing the ring 13 has bearings 32 for one end 23 of each of the six knives, which extend towards the back part of the bar and diverge from one another. The knives 24 are held in their positions in the bearing by a ring 32<sup>1</sup> which is mounted on the sleeve 12 by means of screws 32<sup>11</sup> (Fig. 6). Each knife has an arm 24 which is C-shaped in cross section along the most part of its length, the concave side of each arm 24 being adjacent the bar 11. A straight blade 25, curved blade 26 and a second straight blade 27 are mounted in sequence on the back of each arm 24. Two blades 28 extend, arranged in a V-shape from the blade 27. The cutting edge of each blade 28 has such profile that the two blades as a whole abut with their two edges over their whole length on the wall of the pipe to be cleaned. It is a matter of course that each apparatus for cleaning pipes will be constructed to clean pipes of a definite cross section (having a tolerance of plus or minus some percentages). The blades 25, 26 and 27 cut

into deposits in a pipe being cleaned in a radial plane. The blades 28 break and loosen the deposit previously cut into, in that they penetrate with their apices into the radial cuts produced by the blades 25, 26 and 27. The blades 28 also scrape the pipe wall. So that the deposits can be cut and scraped when the apparatus is being pushed forward in the pipes the ends of the V formed by the knives must be firmly pressed against the pipe wall. This task is effected for each arm 24 by respective leaf springs 29 the one end of which is mounted on to the pyramid part of the sleeve 19 with the help of screws the other end being hooked onto a line 33 which is welded on to the back end of the arm 24. In order to regulate the tension of the springs 29 a hexagon plate 30 is provided, which plate 30 is displaceable on the sleeve 19 and thus can be moved towards or away from the pyramid part of the sleeve 19 with the help of screws 31.

The small displacements of each knife are taken up by the appropriate leaf springs. If one or more of the knives should closely approach the bar 11, for example as a result of hitting a hard mass, the sleeve 19 would be displaced against the action of the spring 17, which would result in all the knives approaching the bar 11 and said bar is, therefore, always situated in the centre of the group of knives.

The arms of the knives can also be so constructed that the back is directed against the bar 11. In this case the blades 25, 26 and 27 will be arranged between the wings of the arms and the wings of the arms will serve also as blades. Such variance in the execution is, for example, applicable for the cleaning of oil pipes, in which the deposits which form are relatively soft.

The number of knives on each tool can consist of any practical number between 4 and 24.

The cutting and scraping tool 3 is constructed similarly to the preceding tool 1, the only difference being that the cutting head 13, 14 is absent. The tool 3 is hinged in such manner, relative to the tool 1, that its knives are displaced by 30° relative to those of the first tool, so that both tools as a whole scrape the whole periphery of the pipe.

The thrusting means 5 is a device (for example of the same type as a turbine) of known type in the field of apparatus for descaling pipes. It utilises a part of the energy of water or other liquid which is forced under pressure into the pipes and—since its speed is greater than that of the apparatus—is used simultaneously to remove the deposits loosened and crushed by the apparatus.

As already stated the thrusting device 5 is followed by a group of two (possibly three) crushing tools 7 and 9, the task of which consists of breaking up the pieces of deposit

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loosened by the knives but which have not been carried along by the current of liquid. The crushing occurs, in that these pieces of crust are crushed between the pipe wall and rollers, as explained later. These rollers are also used to destroy the deposits adhering to the pipe wall after the knives have passed.

The two crushing tools are identical; therefore only one will be described with reference to Figs. 9—11 in the following. The tool encloses a centre bar 41, which has on both ends an eye 42 for coupling, with the help of pins or bolts, to the one and the other of the hinging devices 6 and 8. A hexagon plate 43 is wedged close to the front end of the bar 41, which plate 43 is prevented from rotating by a pin 56 projecting into a groove 58. This plate 43 has 6 radial arms 57. A head 55 is hinged on each of these arms, and one end of a thick steel blade 46 is mounted on each head 55, the other end of each blade supporting a second head on which a barrel-shaped roller 48 is journaled. The radius of the curvature of the rollers 48 are the same as the one used to descale the pipes. The rollers 48 each have several ribs disposed in zig-zag lines, and each consists preferably of discs layered one adjacent the other, of which each has such a rib. The rotary axis of each roller is disposed vertically to the respective bar 41 and the plane containing the arm 46, so that the roller is in contact with the wall of the pipe over its whole width. In its centre axis the bar 41 supports a plate 43<sup>1</sup> which is similar to the plate 43. The plate 43<sup>1</sup> supports arms 46<sup>1</sup> provided with rollers 48<sup>1</sup>. The two roller units are disposed at 30° relative to one another. For adjusting the pressure of the rollers against the pipe wall, two round discs 49 and 52 are provided with conical jacket surface, their distance from each other being decided by two stop members 50, which are mounted on a bar 51 which is welded on to a disc 52. Nuts 54 make it possible to regulate the position of the unit formed by the two discs relative to the hinges on the arms 46 and 46<sup>1</sup>. The plates 43 and 43<sup>1</sup> are blocked axially on the bar 41 by the stop members 53. Instead of six arms 46, only five or even more than six could be provided.

The second crushing tool is coupled to the first in such a manner that its rollers are disposed relative to those of the first tool by 15°, so that the tracks covered by the various rollers overlap one another.

Fig. 6 shows the front part of the scraping tool 3, which differs from tool 1 by the absence of the cutting head.

Fig. 7 is an embodiment of the hinged device 2 (or 4 or 8), which requires no particular explanation.

The ball joint 6 shown in Fig. 8 is of particular construction. It shows an arm 76 which is provided at one end with a spherical head 73 and on the other end with an eye 77. The

ball 73 is enclosed in the cylindrical bush 71/72. The seat of the member 72 is spherical and has the same diameter as the ball 73. This latter is provided with a conical protrusion 74, which corresponds to a conical recess 75 in the base of the cylindrical bush. In operation the hinge is under tensional stress and the ball 73 is supported on the seat of the cups 72. When the apparatus is being inserted into a pipe it is an advantage if the hinge connection between the thrusting unit 5 and the crushing tool is partially rigid, in order to prevent tilting. This strengthening is produced by the protrusion 74 which penetrates into the recess 75 in such manner that the hinged unit 6 acts as a rigid member in relation to the axial stresses.

The task of the blades 26, which are rotatable on the arms 24, consists in the feature of making it easier for the tool 1 to take up impacts, when it strikes hard bodies. The V-shaped arrangement of the blades 28 on the bed 28<sup>1</sup> makes it possible to exert an emulsifying effect on the blades, thanks to the water penetrating into the cavity which is limited in this manner.

In one variant of execution the knives are pressed against the pipe wall by means of an oil pressure system, instead of by metal springs.

#### WHAT I CLAIM IS:—

1. Apparatus for descaling pipes and having a thrust device which makes use of a part of the energy of a liquid flowing through the pipe to be cleaned, characterised by a first unit comprising of at least two cutting and scraping tools, followed by the thrusting device aforesaid, which, for its part, is followed by a second unit comprising at least two crushing tools, the various tools and the thrusting device being connected together by hinges which permit the apparatus to pass through curved pipe sections, and further characterised in that each of the cutting and scraping tools has a row of knives which are arranged in the manner of the edges of a pyramid and which are pressed by means of a flexible system against the wall of the pipe, which system includes a group of springs of which each operates on one of the knives and is mounted on a sleeve displaceable on an axial bar to which the knives are hinged and comprises also a spring which surrounds the bar and pushes back the sleeve, each knife moreover having a front part for cutting into deposits in a radial plane and a back, V-shaped part, for penetrating into grooves produced by the knives for crushing the deposits and simultaneously scraping the pipe wall, whilst the crushing tools have ribbed rollers likewise pressed flexibly against the wall, the whole in such a manner that the V-shaped parts scrape the whole periphery of the wall, and the rollers crush the deposits between themselves and the wall in that they are mainly axially displaced.

2. Apparatus according to claim 1, characterised in that the knives of the second cutting tool are radially displaced with respect to those of the first tool.
- 5 3. Apparatus according to claim 2, characterised in that the knives are provided by arms each of C-shape in cross section, which arms carry on their edges a series of radial blades, which are followed by two blades arranged
- 10 in V-shape, one end of the said arm being pivoted at the front part of the central bar the springs acting on each knife being leaf springs.
4. Apparatus according to claim 2, characterised in that the knives are provided by arms
- 15 each having a C-shaped cross section, the back of which is adjacent to the bar and which in its middle plane carries a series of radial blades which are followed by two blades arranged V-shape one end of the same arm
- 20 being hinged to the front part of the central bar, the springs acting on each knife being leaf springs.
5. Apparatus according to claim 3, characterised in that the second radial blade is
- 25 round.
6. Apparatus according to claim 3, characterised in that the hinged connections are torsionally strong, with the exception of those which connect the thrusting means to the first
- 30 crushing tool.
7. Apparatus according to claim 3, characterised in that the rollers are barrel shaped and are each arranged to rotate on one end of a flexible arm the other end of which is in engagement with a central bar, and that each
- 35 tool has two rings of rollers, the rollers of the one ring being displaced in the peripheral direction relative to those of the other ring.
8. Apparatus according to claim 7, characterised in that the rollers of the second tool are
- 40 displaced in the peripheral direction relative to those of the first tool, in such manner that the paths passed through by the various rollers overlap each other.
9. Apparatus according to claim 8, characterised in that each roller is constructed of
- 45 several discs arranged side by side and each having a rib disposed in a zig-zag line.
10. Apparatus according to claim 9, characterised in that the hinged connection between
- 50 the thrusting device and the first crushing tool is a ball connection and acts as a rigid member in relation to axial pressure forces.
11. Apparatus for descaling pipes substantially as hereinbefore described with reference
- 55 to and as illustrated in the accompanying drawings.

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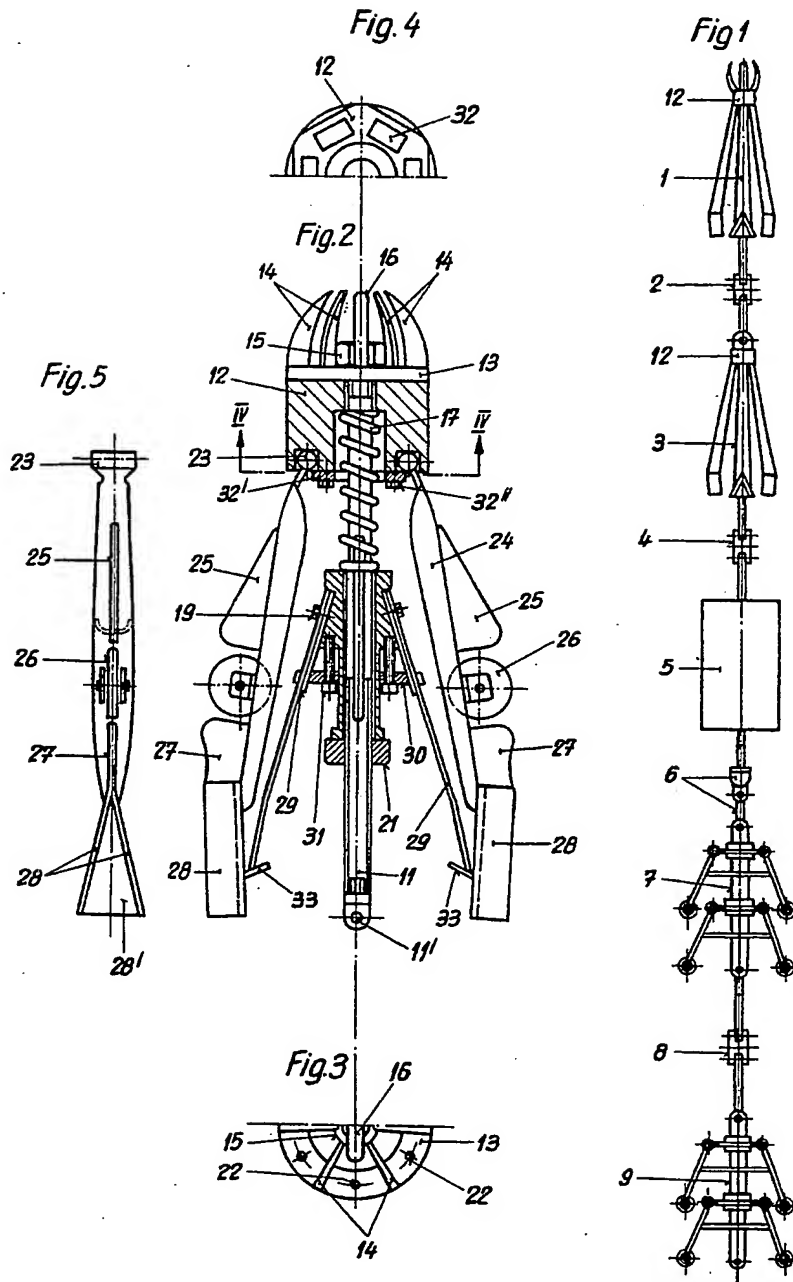


Fig. 8

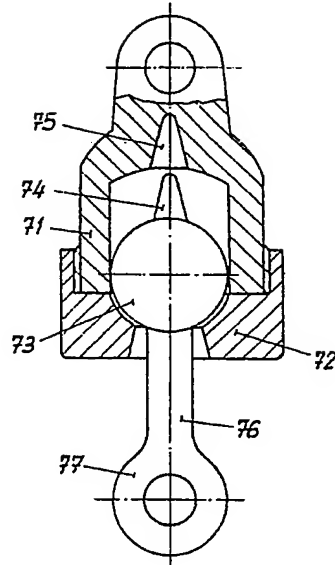


Fig. 7

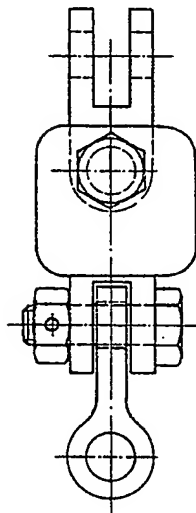


Fig. 6

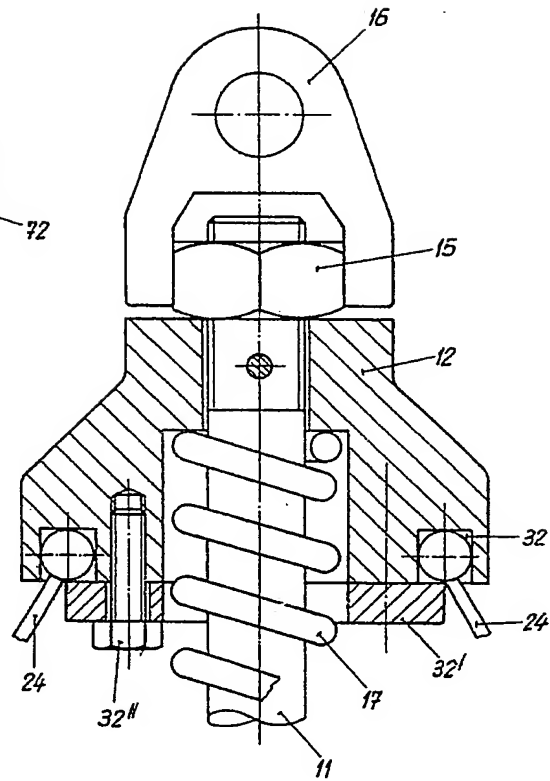


Fig. 10

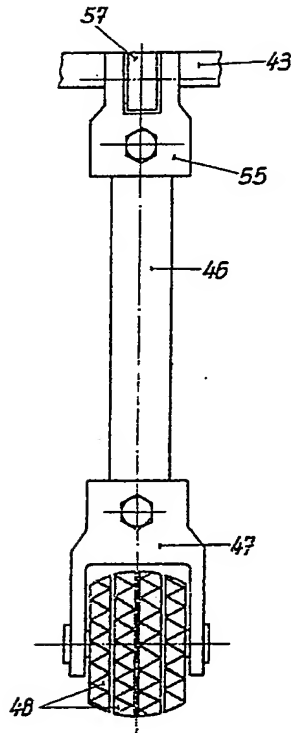


Fig. 9

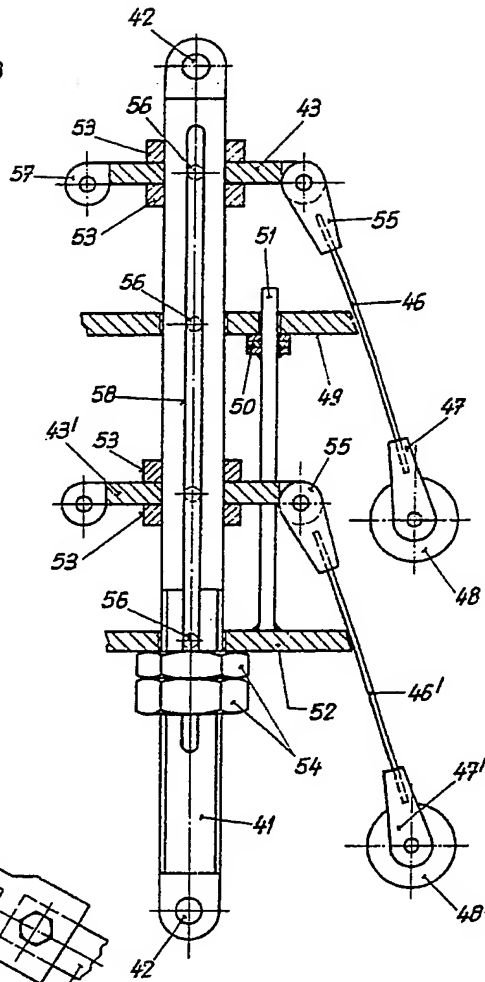
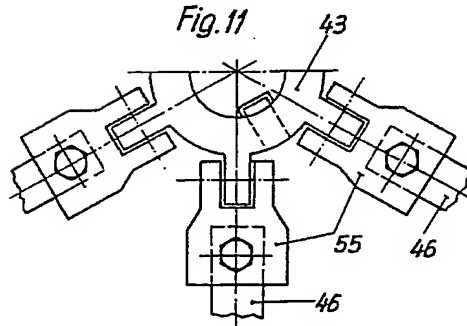


Fig. 11



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